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CLINICAL SECTION

A case of anterior open bite with severely narrowed maxillary dental arch and hypertrophic palatine tonsils

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This case report describes an adolescent patient with an open bite and severely narrowed maxillary dentition and hypertrophic palatine tonsils, treated efficiently with rapid maxillary expansion (RME) and subsequent orthodontic tooth alignment using fixed appliances. The treatment demonstrates that RME can be effective for the correction of a severely narrowed maxillary arch, as well as, in this case, the correction of an anterior open bite in an adolescent patient where no substantial vertical skeletal discrepancy existed.

Key words: Anterior open bite, orthodontic treatment, rapid maxillary expansion, narrowed maxillary dentition, hypertrophic palatine tonsils

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Introduction

An open bite is frequently accompanied with a narrowed maxillary dentition, which may result from mouth breathing. There are various morphological features of skeletal open bite such as negative overbite, large Frankfort–mandibular planes angle (FMPA), mesially inclined molar teeth, narrow maxillary dentition, short ramus height, and downward and backward rotation of the maxillomandibular skeleton.[1] Among them, the narrowed maxillary dentition associated with a posterior crossbite is a major problem for orthodontic treatment, because the relapse of the transverse maxillary dimension may affect the vertical skeletal discrepancy.

Patients with an open bite and with a narrowed maxillary dentition may be subject to mouth breathing resulting from nasopharyngeal obstruction such as adenoid hypertrophy.[2] Constriction of the posterior airway and the subsequent mouth breathing have been put forward as among the critical factors that may cause open bite.[2,3] Hypertrophic tonsils are a nasopharyngeal dysplasia which narrow the airway and produce difficulty in nasal breathing.

In orthodontic treatment during the mixed dentition, dentoalveolar open bite may be corrected by eliminating local environmental causes such as parafunctional habits. However, continuing long-term oral habits exert more severe influences on dentoalveolar morphology.

Given these considerations, the open bite associated with a severely narrowed maxillary dentition often presents a difficulty for orthodontic treatment. Rapid maxillary expansion (RME) is an effective approach for increasing the transverse dimension of the maxillary arch, and has been used frequently in growing patients.[4,5] It is generally suggested that RME is appropriate for patients with a full-cusp crossbite associated with a skeletal component, and some degree of dental as well as skeletal constriction with no preceding dental expansion.[6]

The purpose of this article is to report a case of open bite with a severely narrowed maxillary dentition and hypertrophic palatine tonsils treated with RME and subsequent orthodontic tooth alignment.

Case report

A 13-years, seven-month-old female patient had an anterior open bite with a severely narrowed maxillary dentition (Figure 1). She complained of occlusal, functional and aesthetic disturbances due to the anterior open bite. The molar relationship was Class I on the right side and Class II on the left. Overjet and overbite were 6.0 and −6.5 mm respectively.

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(a) (b)

(c) (d) (e)

(f) (g)

Figure 1 (a,b) Facial and (c–g) intra-oral photographs before treatment (13Y7M)

An open bite was present from the incisor to the premolar regions, together with a bilateral posterior crossbite. The maxillary dentition was severely narrow and V-shaped, whereas the mandibular dental arch form was essentially normal. From the model analysis, the first premolar basal arch width (BAW: the distance between the right and left deepest points of the buccal curvature of basal bone) and coronal arch width (CAW: the distance between the bilateral buccal cusps of the first premolars) of the upper dentition were below the normal range in Japanese girls of the same age, whereas both arch widths of the lower dentition were almost within the normal range (Figure 2). Basal arch length (BAL: basal arch length measured at the midline from a point midway between the central incisors to a tangential touching the distal surfaces of the second premolars) of both the upper and lower dentitions was longer than normal.

The patient had some oral habits, such as finger sucking, tongue thrusting, and mouth breathing. Furthermore, severe hypertrophy of the palatine tonsils was observed (Figure 3). However, surgical resection of the palatine tonsils was not determined as an appropriate treatment in this case by an otorhinolaryngologist, because neither acute tonsillitis nor serious symptoms such as swallowing disturbance were observed. In addition, the patient and her family were reluctant to undergo a surgical invasion.

The panoramic radiograph showed bilaterally impacted lower third molars and congenitally missing upper third molars (Figure 4).

Figure 3 Intra-oral photograph of hypertrophic palatine tonsils (13Y7M)

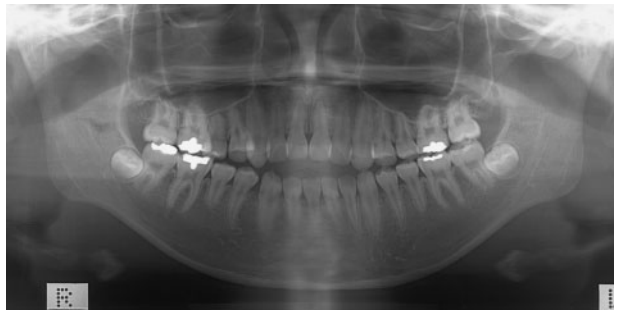


Figure 4 Panoramic radiograph before treatment (13Y7M)

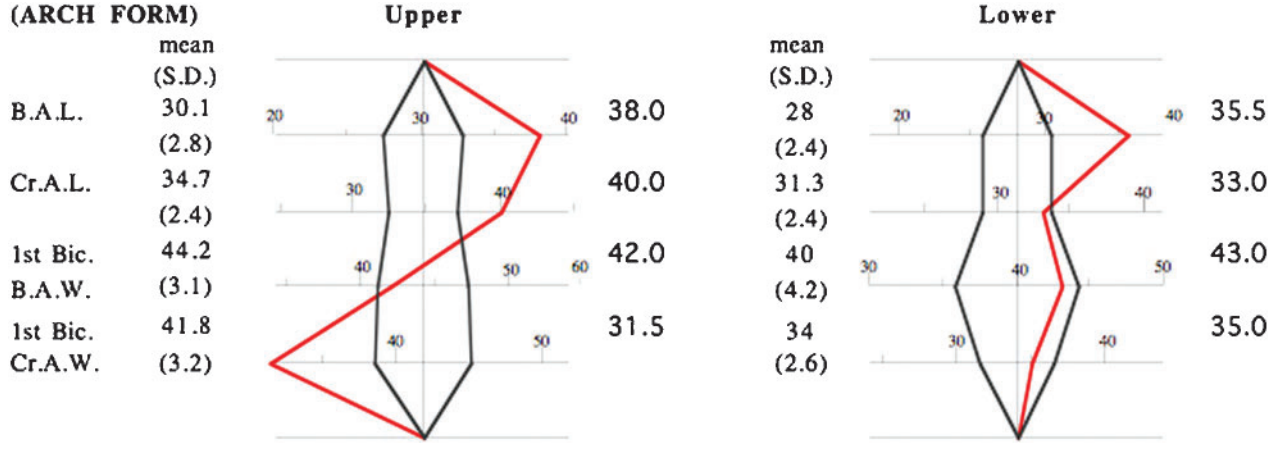


Figure 2 Measurement of the arch form dimensions before treatment (13Y7M). (BAL – basal arch length measured at the midline from a point midway between the central incisors to a tangential touching the distal surfaces of the second premolars. CAL – dental arch length measured at the midline from a point midway between the central incisors to a tangent touching the distal surfaces of the second primary molars. 1st Bic. BAW – the distance between the right and left deepest points of the buccal curvature of basal bone. 1st Bic. CAW – the distance between the bilateral buccal cusps of the first premolars.)

The lateral cephalometric analysis indicated mild features of open bite (Figure 5). The gonial angle (GA) was slightly larger than in the Japanese controls, although the FMPA was within the normal range. The maxillary incisors were proclined, while mandibular incisor inclination was average. Both were within normal range. The postero–anterior cephalometric analysis indicated that the mandibular midpoint (Menton) and dental midline was shifted to the left by 2.0 mm in the intercuspal position, whereas the maxillary dental midline was almost coincident with the facial midline (Figure 6). Although a mild facial asymmetry was observed, the patient had no desire to improve this.

Neither periodontal problems nor temporomandibular joint disorders were found.

From these findings, this patient was diagnosed as having an open bite with severely narrowed maxillary dentition.

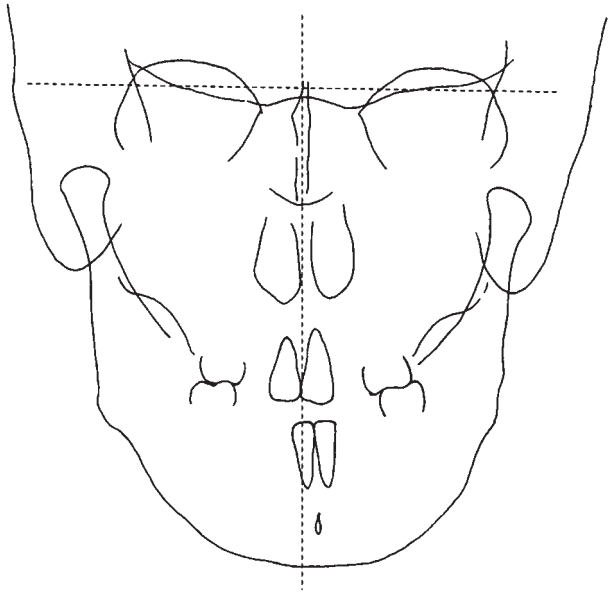


Figure 6 Postero–anterior cephalogram tracing before treatment (13Y7M)

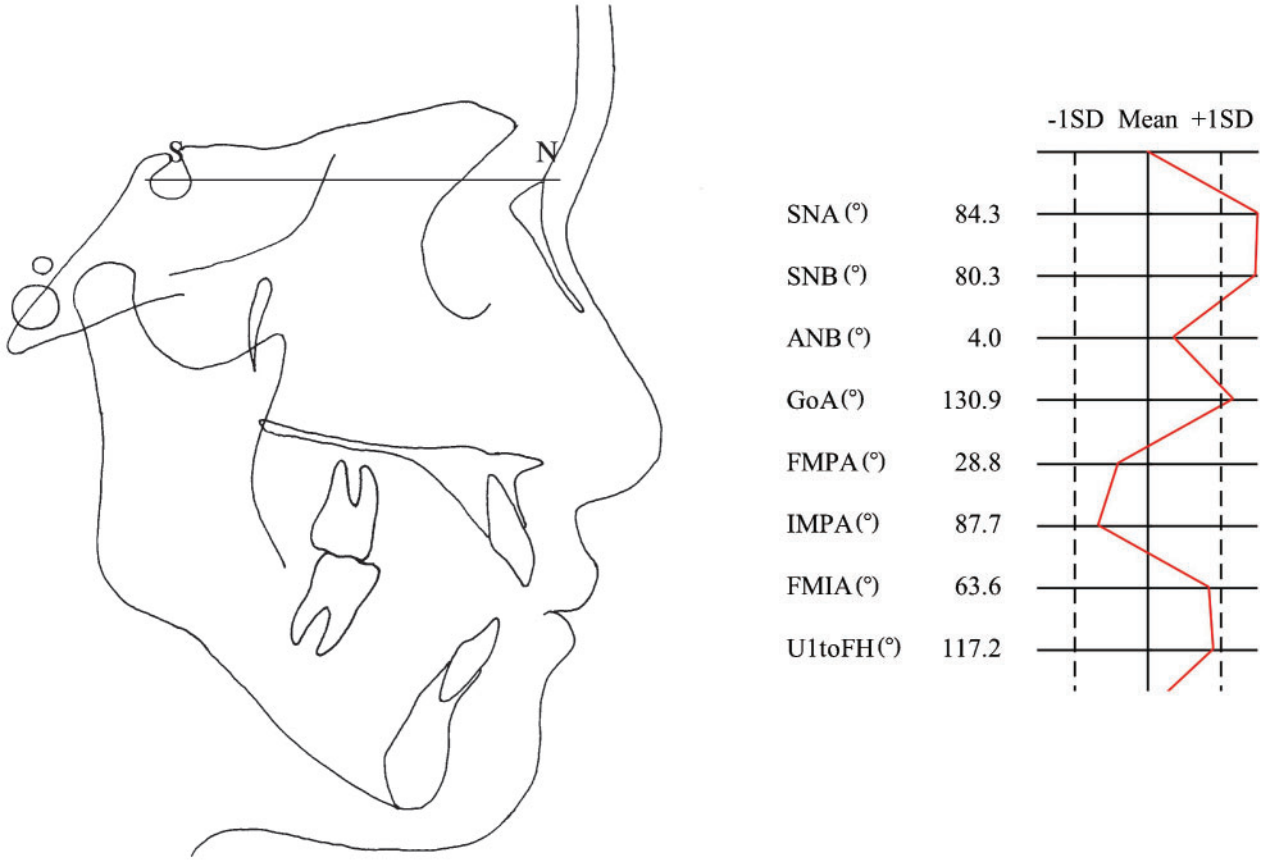


Figure 5 Lateral cephalometric tracing and analysis before treatment (13Y7M). (GA – gonial angle. Angle between mandibular and ramus planes. FMPA – Frankfort–mandibular planes angle. Divergency of the mandibular plane relative to the Frankfort plane. IMPA – incisor–mandibular plane angle. The long axis of the most prominent lower incisor to the mandibular plane. FMIA – Frankfort–mandibular incisor angle. The long axis of the most prominent lower incisor to the Frankfort plane.)

Treatment plan

The treatment plan consisted of four phases:

- A removable tongue crib was to be initially used to prevent finger sucking and tongue thrusting.
- A RME device was then to be applied to the narrowed maxillary dentition.
- Final alignment was to be achieved using upper and lower multi-bracket appliances.
- Retention of the maxillary dentition was to be via a palatal arch and a lingually bonded retainer applied from canine to canine, followed by a Begg type removable retainer (wraparound retainer). Retention of the mandibular dentition was to be via a lingually bonded retainer from canine to canine. Both upper and lower retainers were to be used concurrently.

Treatment progress

The patient was persuaded to stop finger sucking at the first treatment appointment, as she had still continued this habit following the initial consultation. A removable tongue crib was still placed on the lower arch, however, to eliminate tongue thrusting (Figure 7a,b). An RME appliance was placed concurrently on the upper dentition (Figure 7c). After one month of expansion, a palatal arch holding appliance was placed on the upper dentition to retain the expanded maxillary arch (Figure 8). The maxillary BAW increased from 42.0 to 49.8 mm, and the crossbite at the first molar region was corrected. After 3 months retention, the overbite and overjet were improved to −2.0 and 1.0 mm respectively (Figure 9).

There was still a lack of space to accommodate the second molars, and therefore the lower third molars were extracted before tooth alignment with multi-bracket appliances. Six months after the transverse expansion, edgewise appliances were placed. A precision palatal arch appliance was also used to maintain the effects of RME (Figure 10).

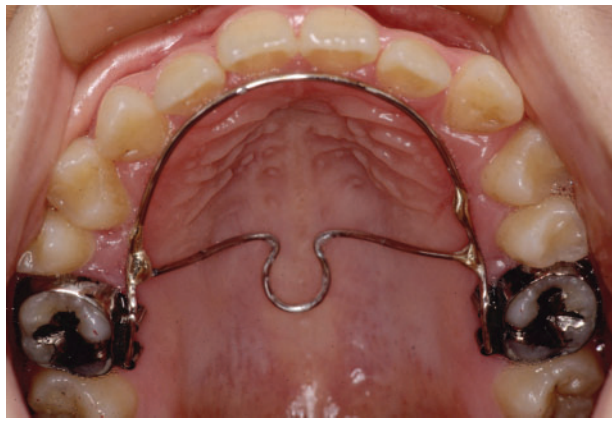


Figure 8 The palatal arch holding appliance used after RME

Twenty-three months after initiating orthodontic treatment with multi-bracket appliances, an acceptable and stable occlusion was achieved. Immediately after debond, lingually bonded retainers were placed on both the upper and lower dentitions from canine to canine (Figure 11). The palatal arch appliance was used continuously on the upper dentition for six months following debond of the multi-bracket appliances (Figure 12). The lingual arch appliance and upper palatally bonded retainer were removed six months later, and a Begg type removable retainer was placed on the upper dentition (Figure 13). The Begg type removable retainer and the remaining lower lingually bonded retainer were worn during the following retention period.

The whole treatment time (from placement of the removable tongue crib and the RME appliance to debond of the multi-bracket appliances) was 41 months. The total retention period was 2 years and 5 months.

(a) (b) (c)

Figure 7 (a,b) The removable type tongue crib. (c) The RME appliance

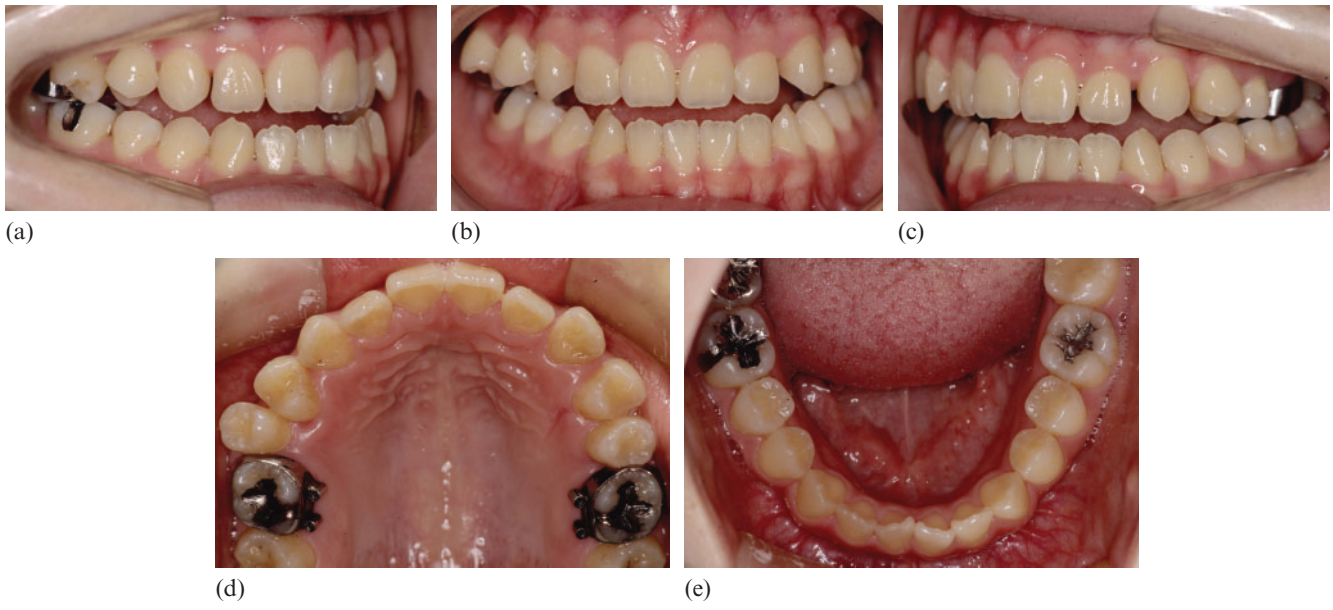


Figure 9 (a–e) Intra-oral photographs after RME (14Y11M)

Results

In comparison with the initial facial profile, an improvement in overall facial balance was achieved (Figure 11). The lips showed less tension in lip closure, although mild facial asymmetry still remained. Acceptable overjet (2.0 mm) and overbite (2.0 mm), along with a Class I molar relationship, were also achieved (Figure 11). The BAW and CAW of the upper dentition became almost normal (Figure 14).

Cephalometric analysis indicated no marked skeletal changes (Figure 15). The position of the mandible was unaltered, and consequently, the maxillo–mandibular planes angle and gonial angle were also unchanged. The upper incisors were retroclined, thereby correcting the incisal inclination. A panoramic radiograph showed no or negligible resorption of the tooth roots or loss of alveolar bone after six months retention (Figure 16).

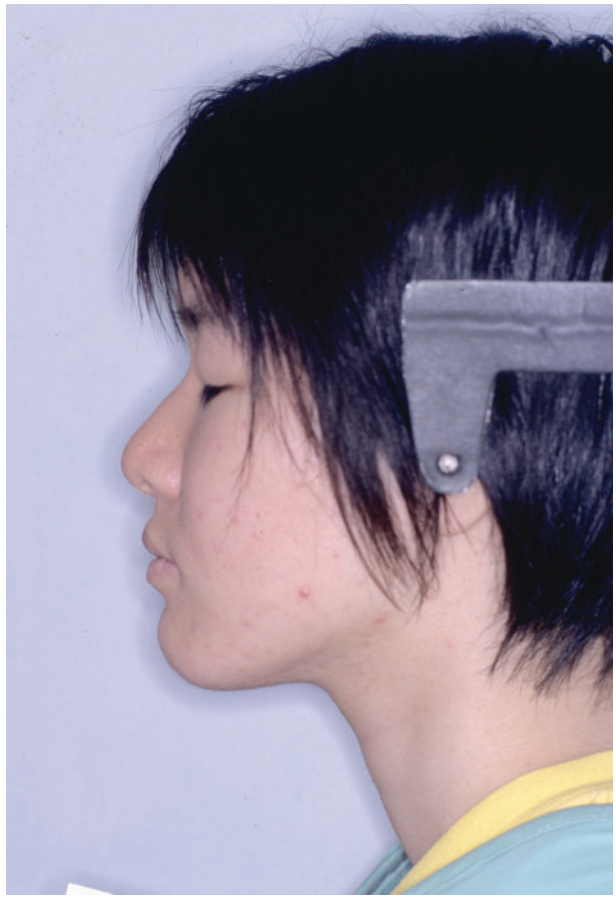
Finger sucking and tongue thrust were eliminated during treatment. After 2 years and 5 months retention, an acceptable occlusion was maintained without any re-occurrence of the anterior open bite, indicating long-term stability of occlusion. Cephalometric analysis indicated no substantial relapse in the skeletal or dental relationships.

It is considered that incisor retroclination, arch expansion and cessation of the finger sucking contributed to the result.

Mouth breathing appeared to improve during treatment, and may have been related to the palatine tonsils decreasing substantially in size when compared to the pre-treatment appearance (Figure 17a). In this case report, mouth breathing was only assessed cephalometrically. Lateral cephalograms have been used for evaluation of the upper airway.[7–10] Since swallowing and other factors can affect the outline of the airway,[11] the patient was requested not to swallow while taking the cephalogram. From the superimposition of airway tracings from lateral cephalograms, obvious enlargement of the whole upper pharyngeal airway was observed after the orthodontic treatment (Figure 17b). However, a more objective method of assessment was not used in this case report.

Figure 10 The palatal arch appliance used with multi-bracket appliances

(a)



(b)

(c)

(d)

(e)

(f)

(g)

Figure 11 (a,b) Facial and (c–g) intra-oral photographs when the multi-bracket appliances were removed (17Y0M)

Figure 12 The palatal arch appliance used for retention of upper dentition

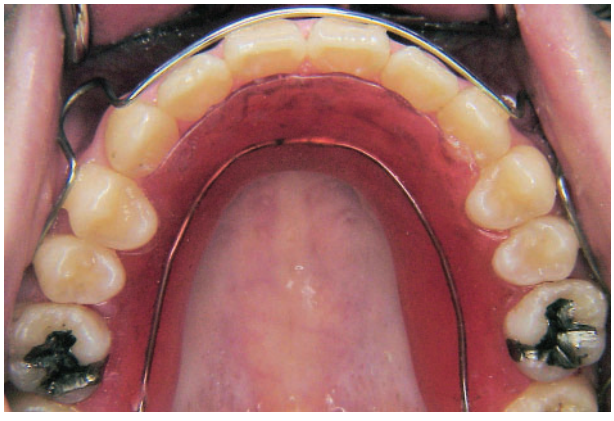


Figure 13 The Begg type removable retainer used for retention of upper dentition

Discussion

The patient exhibited a severely narrowed maxillary dentition. Various studies have shown that, despite the use of mechanical retention for the expanded dentition, there is a strong tendency for the dentition to return to its original form.[12]

It has been suggested[6] that the midpalatal suture expanded by RME remineralizes at least three months after the retention. However, relapse is observed occasionally even after three months retention. One of the major causes of this relapse is thought to be an imbalance between the buccal and lingual soft tissue pressures, which is created as a result of maxillary expansion.[13,14] It has also been suggested[15] that the cheeks and lips adapt to the new position of dental arches after three months retention, whereas tongue adaptation requires comparatively longer. Furthermore, replacing the expansion appliance with a new retainer has been suggested[6] to be of great importance for retaining the expanded dental arch.

The direct effects of RME reported previously include correction of dental crossbites with relief of dental crowding,[16] and reduction in conductive hearing loss due to middle ear and Eustachian tube problems.[17] It has also been suggested that RME may result in expansion of the lateronasal width contributing to a reduction in nasal resistance.[16,18] In addition, RME may serve to induce bone remodelling in the nasal cavity.[19] An acoustic rhinometry study demonstrated that nasal breathing in patients with maxillary constriction was improved by RME.[20] These effects of RME may have contributed to the improvement of mouth breathing in this patient.

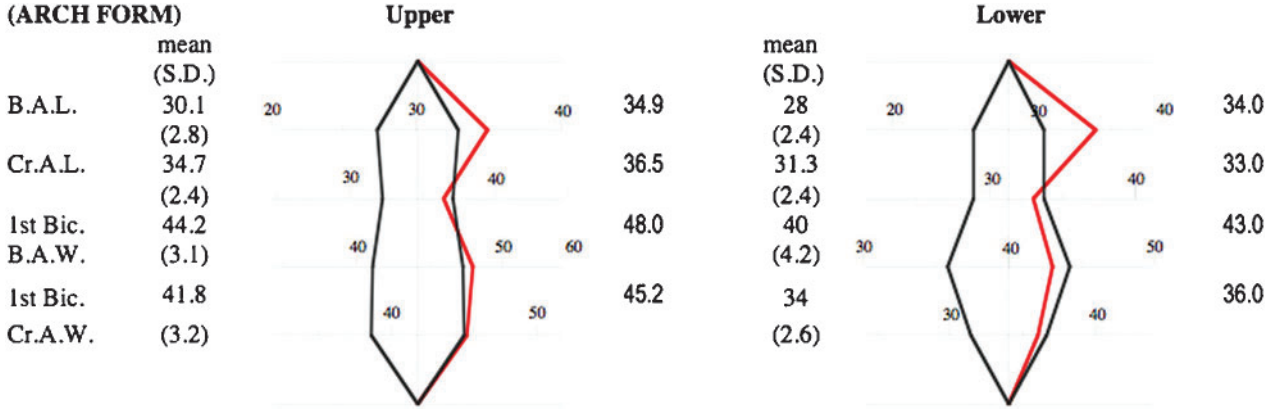


Figure 14 Measurement of the arch form dimensions when the multi-bracket appliances were removed (17Y0M). (BAL – basal arch length measured at the midline from a point midway between the central incisors to a tangential touching the distal surfaces of the second premolars. CAL – dental arch length measured at the midline from a point midway between the central incisors to a tangent touching the distal surfaces of the second primary molars. 1st Bic. BAW – the distance between the right and left deepest points of the buccal curvature of basal bone. 1st Bic. CAW – the distance between the bilateral buccal cusps of the first premolars.)

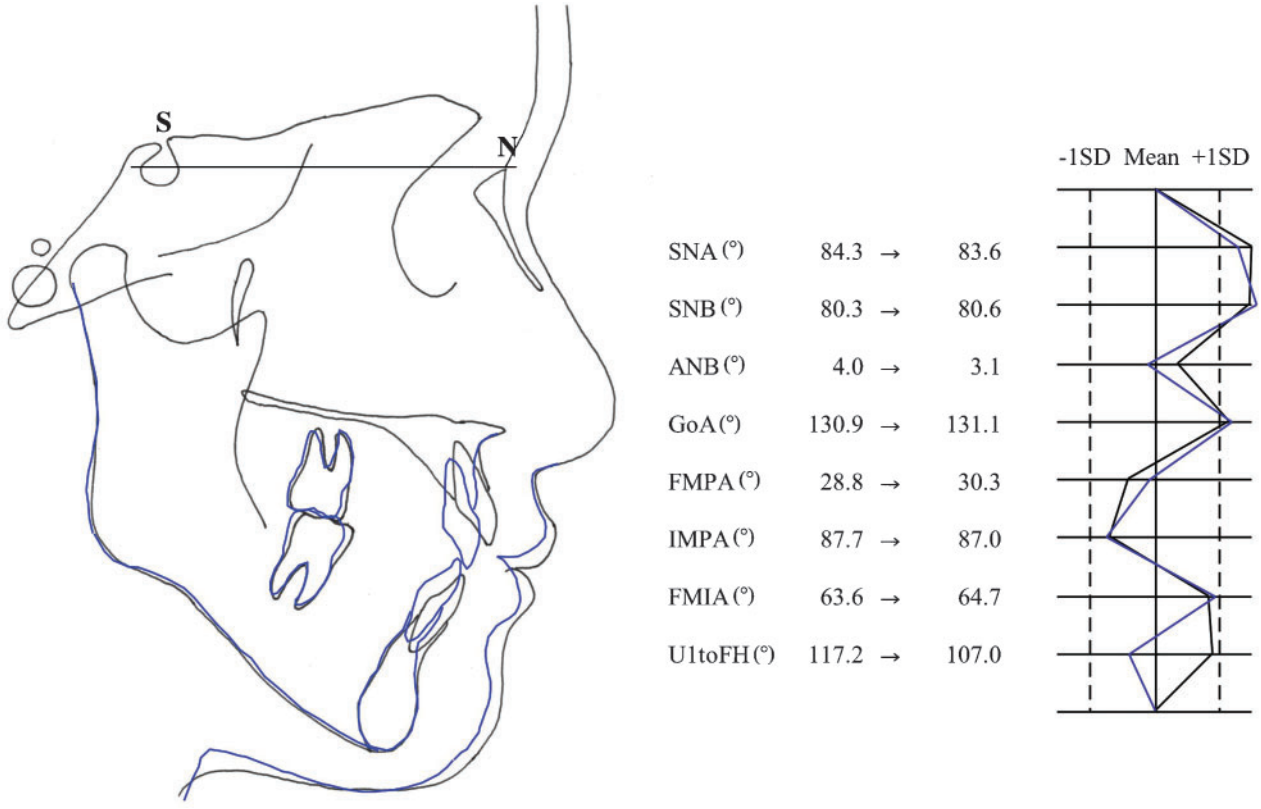


Figure 15 Superimposition of cephalometric tracings before treatment (13Y7M; black line) and when the multi-bracket appliances were removed (17Y0M; blue line). Cephalometric analysis before treatment (13Y7M; black line) and when the multi-bracket appliances were removed (17Y0M; blue line)

Waldeyer's ring is composed of the palatine tonsils, together with pharyngeal tonsil, lateral pharyngeal bands and lingual tonsils. This is a complex of lymphoid tissue encircling the pharynx, and constitutes a primary site of initial exposure to inhaled or ingested antigens.[21] It has been suggested that tonsillar tissues may be more reactive immunologically than other developing lymphoid tissues in the juvenile or early adolescent period.

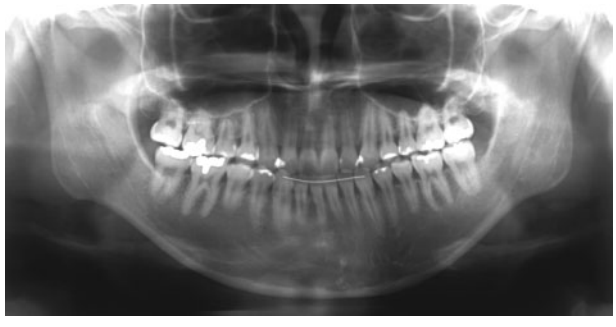
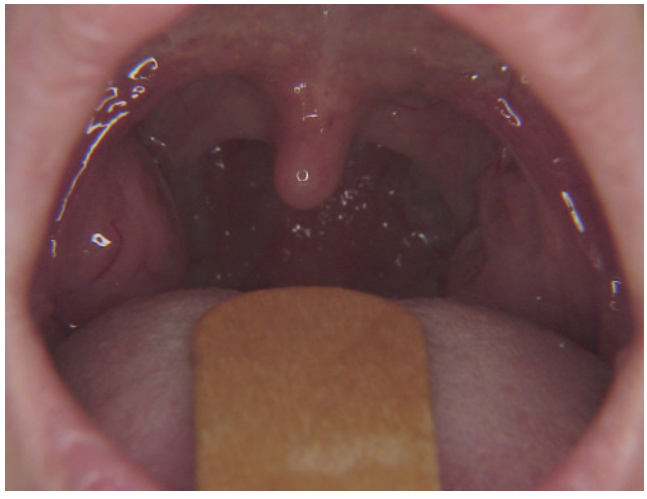


Figure 16 Panoramic radiograph after six months retention (17Y6M)

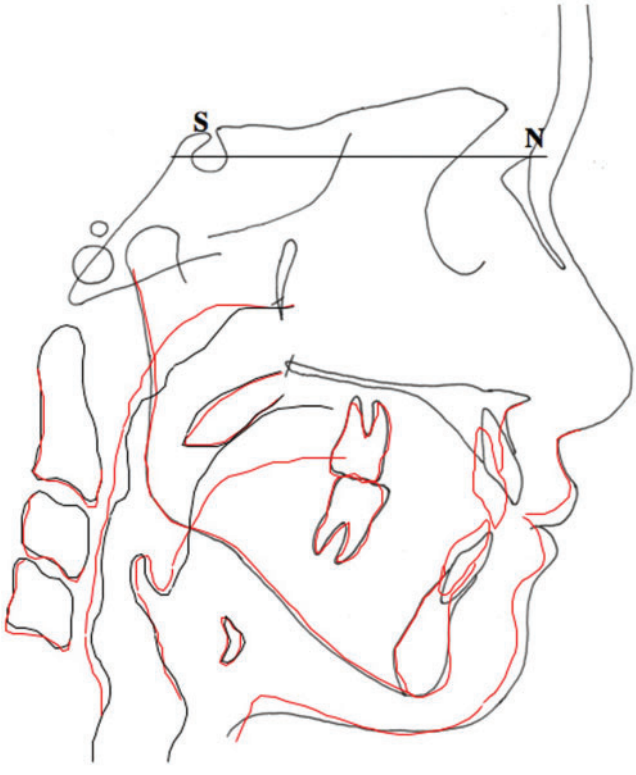
During childhood, the active immunological processes in the tonsils cause a fluctuating physiological enlargement of these organs.[21] However, grossly enlarged tonsils can create an obstruction of the oro-pharyngeal space dorsal to the root of tongue. If the obstruction is severe enough to move the tongue forward to maintain an optimal oro-pharyngeal airway, mouth breathing may result.[22] Behlfelt[21] suggested that the dentoalveolar features in children with hypertrophic tonsils included narrow upper dental arch and posterior crossbite. These children were mostly mouth breathers.[21]

Tonsillectomy is suggested to be effective for repositioning the tongue dorsally, improving mouth breathing, and reducing a tendency for posterior crossbite.[21] However, tonsillectomy may not necessarily be indicated during orthodontic treatment. The main indications for tonsillectomy today are recurrent acute tonsillitis, chronic tonsillitis, and tonsil hyperplasia, which causes mechanical obstruction such as disturbance of respiration, sleep, speech and deglutition.[23]

In the present case, the enlarged palatine tonsils showed a reduction, which may be assumed to be related



(a)



(b)

Figure 17 (a) Intra-oral photograph of palatine tonsils after 44 months retention (19Y5M) and (b) superimposition of cephalometric tracings of airway before treatment (13Y7M; black line) and after 44 months retention (19Y5M; red line)

to the improvement of nasal breathing during the treatment. The reduction of the palatine tonsils was an unexpected event during the orthodontic treatment. It is speculated that some external factors such as orthodontic treatment (in particular RME) and reductions in oral habits might have contributed to the reduction in the size of tonsils and improvement of the oro-pharyngeal airway problems in this growing patient.

In this case, RME was used to expand the maxilla leading to the correction of the posterior crossbite. To achieve skeletal but not dental expansion of the maxilla, orthopaedic separation of the midpalatal suture was required. For this purpose, the RME was considered to be more suitable than a quadhelix. At the same time, the discrepancy in the maxillary arch was decreased, and the space for anterior teeth alignment was acquired. The inclination and position of the upper incisors was also corrected by maxillary expansion and tooth alignment with multi-bracket appliances. Alignment of the upper incisors facilitated lip closure. This improvement might have contributed further to any reduction in mouth breathing and tongue thrusting.

Conclusion

The result of this treatment indicated that RME was an effective approach to correction of a severely narrowed maxillary dental arch accompanied with anterior open bite in this adolescent patient, where there was no underlying vertical skeletal discrepancy.

References

1. Miyajima K, Iizuka T. Treatment mechanics in Class III open bite malocclusion with Tip Edge technique. *Am J Orthod Dentofacial Orthop* 1996; **110:** 1–7.
2. Linder-Aronson S. Adenoids. Their effect on mode of breathing and nasal airflow and their relationship to characteristics of the facial skeleton and the denition. A biometric, rhino-manometric and cephalometro-radiographic study on children with and without adenoids. *Acta Otolaryngol Suppl* 1970; **265:** 1–132.
3. Proffit WR, Ackerman JL. Diagnosis and treatment planning in orthodontics. In: Graber TM, Vanarsdall RL (Eds). *Orthodontics: Current Principles and Techniques*, 2nd Edn. St Louis: Mosby, 1994, 1–95.
4. Ladner PT, Muhl ZF. Changes concurrent with orthodontic treatment when maxillary expansion is a primary goal. *Am J Orthod Dentofacial Orthop* 1995; **108:** 184–93.
5. Handelman CS, Wang L, BeGole EA, Haas AJ. Nonsurgical rapid maxillary expansion in adults: report on 47 cases using the Haas expander. *Angle Orthod* 2000; **70:** 129–44.
6. Proffit WR. Orthodontic treament planning: limitations and special problems. In: Proffit WR, Fields HW (Eds). *Contemporary Orthodontics*. St. Louis: Mosby, 1986, 198–225.

7. Ozbek MM, Miyamoto K, Lowe AA, Fleetham JA. Natural head posture, upper airway morphology and obstructive sleep apnoea severity in adults. *Eur J Orthod* 1998; **20:** 133–43.
8. McNamara JA, Jr. A method of cephalometric evaluation. *Am J Orthod* 1984; **86:** 449–69.
9. Cohen D, Konak S. The evaluation of radiographs of the nasopharynx. *Clin Otolaryngol Allied Sci* 1985; **10:** 73–78.
10. Poole MN, Engel GA, Chaconas SJ. Nasopharyngeal cephalometrics. *Oral Surg Oral Med Oral Pathol* 1980; **49:** 266–71.
11. Major MP, Flores-Mir C, Major PW. Assessment of lateral cephalometric diagnosis of adenoid hypertrophy and posterior upper airway obstruction: a systematic review. *Am J Orthod Dentofacial Orthop* 2006; **130:** 700–8.
12. Vardimon AD, Brosh T, Spiegler A, Lieberman M, Pitaru S. Rapid palatal expansion: part 1. mineralization pattern of the midpalatal suture in cats. *Am J Orthod Dentofacial Orthop* 1998; **113:** 371–78.
13. Bell RA. A review of maxillary expansion in relation to rate of expansion and patient's age. *Am J Orthod* 1982; **81:** 32–37.
14. Mew J. Relapse following maxillary expansion. a study of twenty-five consecutive cases. *Am J Orthod* 1983; **83:** 56–61.
15. Kucukkeles N, Ceylanoglu C. Changes in lip, cheek, and tongue pressures after rapid maxillary expansion using a diaphragm pressure transducer. *Angle Orthod* 2003; **73:** 662–68.
16. Hartgerink DV, Vig PS, Abbott DW. The effect of rapid maxillary expansion on nasal airway resistance. *Am J Orthod Dentofacial Orthop* 1987; **92:** 381–89.
17. Laptook T. Conductive hearing loss and rapid maxillary expansion. report of a case. *Am J Orthod* 1981; **80:** 325–31.
18. Warren DW, Hershey HG, Turvey TA, Hinton VA, Hairfield WM. The nasal airway following maxillary expansion. *Am J Orthod Dentofacial Orthop* 1987; **91:** 111–16.
19. Walters RD. Facial changes in the Macaca mulatta monkey by orthopedic opening of the midpalatal suture. *Angle Orthod* 1975; **45:** 169–79.
20. Doruk C, Sokucu O, Sezer H, Canbay EI. Evaluation of nasal airway resistance during rapid maxillary expansion using acoustic rhinometry. *Eur J Orthod* 2004; **26:** 397–401.
21. Behlfelt K. Enlarged tonsils and the effect of tonsillectomy. Characteristics of the dentition and facial skeleton. Posture of the head, hyoid bone and tongue. Mode of breathing. *Swed Dent J Suppl* 1990; **72:** 1–35.
22. Subtelny JD. Oral habits – studies in form, function, and therapy. *Angle Orthod* 1973; **43:** 349–83.
23. Bluestone CD. Current indications for tonsillectomy and adenoidectomy. *Ann Otol Rhinol Laryngol Suppl* 1992; **155:** 58–64.